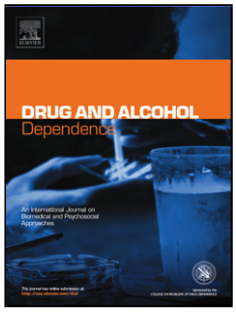
DOI:
10.1016/j.drugalcdep.2017.12.018

Document Version
Peer reviewed version



Title: Acceptance and patterns of personal vaporizer use in Australia and the United Kingdom: results from the international tobacco control survey

Authors: Cheolmin Lee, Hua-Hie Yong, Ron Borland, Ann McNeill, Sara C. Hitchman

PII: S0376-8716(18)30076-0
DOI: https://doi.org/10.1016/j.drugalcdep.2017.12.018
Reference: DAD 6805

To appear in: *Drug and Alcohol Dependence*

Received date: 22-7-2017
Revised date: 6-12-2017
Accepted date: 20-12-2017

Please cite this article as: Lee, Cheolmin, Yong, Hua-Hie, Borland, Ron, McNeill, Ann, Hitchman, Sara C., Acceptance and patterns of personal vaporizer use in Australia and the United Kingdom: results from the international tobacco control survey.Drug and Alcohol Dependence https://doi.org/10.1016/j.drugalcdep.2017.12.018

Acceptance and patterns of personal vaporizer use in Australia and the United Kingdom: results from the international tobacco control survey

Cheolmin Lee[1], Hua-Hie Yong[2], Ron Borland[2], Ann McNeill[3,4], Sara C. Hitchman[3,4]

[1]Department of Family Medicine, Healthcare System Gangnam Center, Seoul National University Hospital, Seoul, South Korea

[2]Nigel Gray Fellowship Group, Cancer Council Victoria, Melbourne, Australia

[3]Department of Addictions, Institute of Psychiatry, Psychology, and Neuroscience, King's College London, United Kingdom

[4]UK Centre for Tobacco and Alcohol Studies (UKCTAS), University of Nottingham, Nottingham, United Kingdom

Correspondence

Ron Borland

Nigel Gray Fellowship Group, Cancer Council Victoria

615 St Kilda Rd, Melbourne VIC 3004, Australia

Tel: 61-3-9514-6291

Ron.Borland@cancervic.org.au

Highlights

- Vaping was more socially accepted in the UK than in Australia.
- Vaping level in homes and smoke-free public places reflects regulatory environment.
- Social acceptance of vaping increases with exposure and experience.

Abstract

Background: This study examined the prevalence and correlates of (1) perceived social acceptability of personal vaporizer (PV)/e-cigarette use, and (2) reported vaping in public and private places, in the UK and Australia with different regulatory environments for PVs.

Methods: Data analyzed come from 2849 smokers and recent ex-smokers in the UK and Australia who participated in the 2014 wave of the International Tobacco Control Survey.

Results: UK respondents were more likely to think vaping is socially acceptable than Australians (56.4% vs. 27.9%; p<0.001). Having quit smoking, observing vaping in smoke-free (SF) public places, and believing vaping is less harmful than smoking was all significantly associated with greater perceived social acceptability of vaping in both countries. However, vaping status and that of friends and family were more influential in Australia than in the UK. Vaping was reported as much more common in private, than public, settings in both countries. UK vapers were more likely to report vaping in SF public places (OR=2.66; 95% CI=1.5-4.7; p<0.01) and at home (OR=2.44; 95% CI=1.5-3.9; p<0.001), but not in their car when controlling for demographic factors and vaping and smoking status.

Conclusion: The acceptability of vaping was greater among those who were more exposed to vaping and not just among those with some personal experience of vaping, suggesting no strong social barriers to increased use. Vaping in SF public places was less common than in

homes, and both were more common in the UK than in Australia, suggesting some social constraints on use, particularly in Australia.

Keywords: electronic cigarette, personal vaporizers, vaping, smoke-free places, survey research, social norms

1. Introduction

Electronic cigarettes, perhaps better described as personal vaporizers (PVs), are battery-powered devices which heat a liquid that typically contains nicotine and flavors to produce a vapor to be inhaled by the user. PV users describe themselves as vapers. PV use has been increasing globally since they were first introduced to the market by Chinese entrepreneurs in 2003 (Eriksen et al., 2015; Gravely et al., 2014). However, vaping has also attracted much controversy (Breland et al., 2014; Chapman, 2013; Etter, 2013). It has been argued that PVs hold great promise both as a disruptive technology that may, in conjunction with existing tobacco control strategies, help eliminate smoking and as a harm reduction tool for those who are unable or unwilling to quit nicotine use altogether (Yong et al., 2015). However, others are concerned that levels of harm of PVs may be greater than proponents argue (Qasim et al., 2017), that vaping, being similar to smoking, might undermine the denormalization of smoking (Fairchild et al., 2014), and could lead to smoking or PV uptake among young people and never smokers, especially those who would otherwise not use nicotine (Chapman, 2015; Lee et al., 2014).

Because of the public debate, governments are uncertain about how PVs should be regulated; thus there is wide variation in approaches. For example, a report from the Institute

for Global Tobacco Control which summarised policy approaches in a total of 123 countries showed that PVs had been completely prohibited in three countries, prohibited in enclosed public places in 15 countries, and restricted on certain public transportation in three countries (Institute for Global Tobacco Control, 2015). In other countries, the approach is strongly influenced by implications of pre-existing laws controlling nicotine, with countries where nicotine outside of smoked tobacco was effectively banned being more restrictive than those where they are treated as tobacco products and allowed as consumer products. In Australia (AU), for example, there are no national laws specifically addressing the regulation of PVs, but other existing laws relating to poisons, therapeutic goods and some state-based laws on smoke-free (SF) places apply to PVs (Yong et al., 2015). PVs containing nicotine cannot be legally sold but can be used for therapeutic purposes with a doctor's prescription. Non-nicotine containing PVs can be sold and used lawfully except in one state where the devices cannot be sold on the grounds that they look like cigarettes (Yong et al., 2015). By contrast, in other countries like the UK, the use of PVs is cautiously embraced, and there are fewer regulations on the marketing and sale of PVs, and they are currently available as consumer products. The UK Medicines and Healthcare Products Regulatory Agency (MHRA) also regulates PVs that make therapeutic claims as medicines with a fast-track path to registration (Medicines and Healthcare Products Regulatory Agency, 2013), but none were available at the time of this survey. This study was also completed before EU Tobacco Products Directive (TPD) came into effect on 20 May 2016 which prohibited all cross-border marketing. PVs for recreational use containing more than 20mg/ml of nicotine are now only allowed if they are registered as therapeutic products, with those under this level regulated as consumer products (Action on Smoking and Health, 2016), restrictions that are still much less restrictive than in Australia. Not surprisingly, awareness of PVs among ever-smokers has been relatively high in the UK (54% in 2010) compared to the more restrictive Australia (20% in 2010) where the

sale of PVs with nicotine is not permitted (Adkison et al., 2013). The difference in awareness persisted at least until 2013 and was also accompanied by higher use in the UK (Yong et al., 2015).

Although studies have assessed where people choose to smoke and exposure of non-smokers to second-hand smoke (SHS) (Hyland et al., 2009; King et al., 2014; Sureda et al., 2015), few studies have examined vaping in SF public places and private areas such as homes and inside cars. The extent of use, particularly in public, is likely to be influenced by the attitudes towards vaping of both users and the public (Ajzen, 2011; Borland, 2014). Thus, one would expect that social normative beliefs such as perceived social acceptability of vaping would predict where people will vape and how comfortable they are doing so in public and private areas (Borland et al., 2006). If increased exposure to vaping among non-vapers is associated with more negative attitudes, it would suggest social pressures to limit its use. However, if the converse, then we might expect some increase in use purely due to its increased social acceptance.

SF policies are highly complied with (Callinan et al., 2010) suggesting that the extent of vaping may also be affected by policies as to where vaping is allowed, and possibly also the extent of SF policies. All workplaces including restaurants and bars became smoke-free in the UK from 2007 and in Australia a gradual extension of restrictions, essentially complete in 2007 (Cooper et al., 2010; Hyland et al., 2012).

Vapers are more likely than non-vapers to believe that PVs are less harmful than conventional cigarettes (Yong et al., 2016). However, the relationship between risk perceptions of PVs and social acceptability of vaping has not been studied but is predicted to be negative. Perceived risk of PVs relative to conventional cigarettes was shown recently to differ between Australia and the UK among current and former smokers, consistent with the regulatory environment for PVs described earlier for the two countries (Yong et al., 2016).

Thus, one would expect that in private and public places PV use would be higher and attitudes toward PV use would be more positive, in the less restrictive PV regulatory environment of the UK than in the more restrictive environment in Australia. This study aimed to examine the prevalence and correlates of (1) perceived social acceptability of PV use, and (2) reported vaping in SF public places and private places such as home and car, in the UK and Australia with different regulatory environments for PVs.

2. Methods

2.1. Sample

Data came from the 2014 survey wave of the Australian and the UK arms of the International Tobacco Control (ITC4) Four Country project, a longitudinal cohort survey of adult smokers conducted via either web surveys or telephone interviews. The surveys were conducted from August to December 2014 both in Australia and in the UK (2014 adult daily smoking rate=14.5% (ABS, 2015) and 18.7% (Office for National Statistics, 2016), respectively). Details about the study design and sampling methods have been described elsewhere (Fong et al., 2006).

Briefly, the 2014 survey respondents were aged 18 years or older, had smoked at least 100 cigarettes in their lifetime. Some were from previous cohorts (n=2097) and some newly recruited (n=849). The ITC4 cohort was constructed with probability sampling methods using random-digit dialing from the population of each country within strata defined by geographic region and community size, which was designed to be broadly representative of its respective population. For analysis, all respondents who were not aware of PVs (n=97) were excluded, the resulting in final sample size of 2849 respondents (1419 in UK and 1430 in Australia).

2.2. Measures

As part of the preamble to questions on PV use, they were characterized with a list of descriptors including “e-cigarette” and “vape pen”. For this paper, PV was the preferred term

given its increasing use by vapers to avoid the cigarette connotation and associated attributes even though e-cigarette was used as the primary descriptor in the questions. Binary questions were asked about PV awareness, trial, and use. Ever users were asked about extent if any of current use: (daily; less than daily, but at least once a week; occasionally, but less than weekly; and not at all). Past triers were those who had at least tried a PV but were not currently using.

2.2.1. Outcome Variables. Social acceptability was assessed by: "In your opinion, how socially acceptable or unacceptable is it to use e-cigarettes?" (5 categories from "desirable" to "very unacceptable"). Current vapers were asked about whether or not they used PVs in the last 30 days: "in situations where smoking ordinary cigarette is not allowed?" (every day/some-days, rarely/not at all), "inside your home?" (yes/no) and "in your car?" (yes/no).

2.2.2. Predictor Variables. Perceived harmfulness of PVs was assessed by: "Do you think e-cigarettes are more harmful than regular cigarettes, less harmful, or are they equally harmful to health?". The number of friends and family who vape regularly was assessed by: "Among your friends and family, how many if any, do you know who use e-cigarettes regularly?" (none/ only 1 person/ 2 or more). PV use seen in smoke-free public places was assessed using: "In the last 30 days, how often, if at all, have you seen anyone using e-cigarettes in public places where smoking cigarette is banned?" (every day/ some-days/ rarely/ not at all).

Current vapers were asked separately "How comfortable do you feel about using e-cigarettes in public? / around friends? / and around family?". Responses were: very comfortable/ comfortable/ neutral/ uncomfortable/ very uncomfortable/ so uncomfortable that I stopped using in this situation. Finally, ever vapers were asked to rate on a 5-point agree-disagree rating scale the statement: "You enjoy(ed) using e-cigarettes". Data on age, gender,

household income, education level, ethnicity status (white/ non-white [UK], and English speaking at home vs. not [Australia]), survey mode (telephone vs. internet), wave of recruitment (previously recruited vs. newly recruited), and smoking status (quitters vs. current smokers) were also used. Details on education and household income have been described elsewhere (Yong et al., 2015) and as per past ITC studies, they were categorized into high, moderate, and low with Don't Know/Refused responses as a separate category.

2.3. Statistics

Prevalence estimates and 95% confidence intervals were computed for outcomes of interest and compared between AU and the UK, using chi-square test. Where overall country differences were found, adjusted residuals were used to determine where the differences lie for variables with more than two categories. Multivariate logistic regression models were employed to examine independent factors associated with perceived social acceptability (acceptable vs. otherwise) of PV use. Sociodemographic factors (age, sex, education attainment, household income, ethnicity status, wave of recruitment, and mode of survey) and variables about smoking and vaping (smoking status, vaping status, number of friends/family who vape regularly, and observing PV use in SF public places, and harmfulness of vaping compared to smoking) were entered to determine their independent association with the outcome. Analyses of factors associated with reported PV use in three areas (SF public places/ home/ their car) were investigated using similar methods. To determine whether factors associated with the outcome of interest differed between countries, we tested for interaction by country using predictors by country interaction terms in the models. Where significant differences were found, analyses were repeated separately by country. All analyses were conducted using Stata version 14.0.

3. Results

3.1. Sample Characteristics

Of 2849 participants from Australia and the UK who were analyzed, 74.9% were current smokers with the rest being recent quitters (see Table 1). Prevalence of current vaping (defined as any use of PVs) in the UK was more than twice that of AU (28.2% vs. 11.9%), and prevalence of daily use in the UK was about 4 times that of AU (9.2% vs. 2.5%). The proportion of younger (under 40 years old) and older (60 years old or more) was higher in the UK than AU. More of the Australians had higher household income ($p<0.001$) than the UK but fewer Australians were current smokers ($p=.038$). In addition, fewer Australian respondents were new recruits ($p=0.028$), but more were surveyed via the internet ($p<0.001$). There were no by-country differences by gender, education, and ethnicity.

3.2. Attitudes Towards Vaping in Private and Public Places

Compared to Australian respondents, UK respondents were more likely to think that PVs are socially acceptable (56.4% vs. 27.9%, $p<0.001$) and also more likely to believe that PVs are less harmful than conventional cigarettes (63.9% vs. 48.7%, $p<0.001$) (see Table 2). Interestingly, among current vapers of the two countries (see Table 2 lower half), there were no significant differences in perceived comfortableness of vaping in public ($p=0.055$, trend favoring UK), around friends ($p=0.832$) and family ($p=0.399$).

In general, vapers were more likely to report vaping in private spaces (67.9% at home, 56.2% in the car) than in SF public places (27.7%, see Table 2). UK vapers were more likely to use PVs in SF public places (33.9% vs 13.2%, $p<0.001$) and at home (75.1% vs 50.9%, $p<0.001$) than AU vapers, although there were no significant differences of PV use in their car (58.4% vs. 51.5%, $p=0.472$) between the two countries.

3.3. Factors Associated with Perceived Social Acceptability of Vaping

Overall, after adjusting for relevant variables (in Table 3), UK respondents were more than twice as likely to perceive vaping as a socially acceptable activity as compared to their Australian counterparts (adjusted odds ratio [aOR]=2.11, 95% confidence interval [CI]=1.76-

2.55; p<.001). The results for social acceptability were reported for each country separately (Table 3) as we found significant by-country interaction for social acceptability towards PV use (p=.002). In the two countries, having quit smoking, believing PVs to be less harmful, and having seen vaping in SF public places were all significantly associated with higher social acceptability of PV use. It is notable that responding on the internet, as compared to phone, was associated with lower reported acceptance. Knowing regular vapers was significantly associated with greater social acceptability in AU but not in the UK. Current vaping was associated with increased acceptance in both countries, as was past vaping in Australia but not in the UK. Finally, there was an age interaction with those under 40 in the UK being more accepting than those aged 60 and older (aOR=1.71; 95% CI=1.19-2.44; p=0.003), while there was no age gradient in Australia.

3.4. Factors Associated with Reported Vaping in Private and Public Places

The factors associated with vapers' use in private and public places shown in Table 4 are based on pooled country analyses as no significant by country interaction was found (p=0.600 for vaping in SF public places; p=0.850 for vaping at home; p=0.663 for vaping in the car). As above, country differences were confirmed for SF public places and homes but not inside cars. The only consistent predictor across the three venues was that, unsurprisingly, daily vapers were more likely to report use than less than weekly vapers. As can be seen from Table 4, reporting enjoying vaping and feeling comfortable around family were associated with greater likelihood of use in SF public places, while high income (compared to low income) and surprisingly the belief that PVs are less harmful than smoking was associated with less use.

For vaping at home, apart from being from the UK and daily vaping, those more likely to use were those who reported enjoying vaping, those comfortable about vaping in front of their family and believing that PVs are less harmful, but those with high income

reported less use at home than low-income respondents. For vaping in cars, daily vapers were more likely to do so than monthly vapers.

4. Discussion

4.1. Main Findings

Our findings showed that the prevalence of PV use in private and public places and attitudes toward vaping were substantially different between AU and the UK in ways consistent with the differences in PV control policies between the two countries. UK vapers tended to vape more frequently at home and in SF public places, and had more positive attitudes toward vaping, compared to AU vapers. Consistent with how awareness, trial, and use of PVs were influenced by different regulatory environments (Yong et al., 2015), our findings suggest that PV regulations might also influence place of PV use and attitudes toward vaping in predictable ways (Ajzen, 2011; Borland, 2014).

It is interesting that while there were different attitudes (social acceptability and perceived harmfulness) among vapers in the two countries, current vapers reported a similar level of comfort toward vaping around other people. Australian vapers reported they were less likely than their UK counterparts to vape in smoke-free public places and at home, but equally likely in their cars. The latter might be due to differences in a number of vapers driving by themselves, and there might be more of them in Australia. Vapers driving with passengers might not want to expose fellow passengers to second-hand vapor within the confined space inside the car as opposed to home and public places where it is possible to move outside the range of the visible vapor. Future study is needed to test this hypothesis as the survey did not assess vaping behavior when alone versus with passengers. In the UK with less tight PV regulation and higher prevalence of vaping than AU, respondent vaping status and having more family and friends who vape regularly, and observing public vaping are less

related to perceived social acceptability than in Australia, perhaps reflecting a more general belief that society, in general, was more accepting of PV use.

There were also some consistent effects across countries: daily PV users tended to vape more frequently in public as might be expected, and those who reported two or more regular vapers around them were more likely to do so. We found some interesting features of vapers according to whether they vape in private or public places. Sociodemographic factors were not associated with PV use in the three areas studied, but those with higher income were less likely to report vaping in SF public places. It is not clear whether this is due to greater need to comply in areas where vaping is also prohibited, or greater reluctance to be seen vaping. The reasons for the low levels of vaping in non-smoking areas, are likely due to one or more of the following factors such as vaping being covered by the same restrictions or social expectations, not to vape in non-smoking areas and a general reluctance to be seen vaping in public. Future surveys should ask about places where vaping is allowed, but smoking is not to tease these elements apart.

Vapers who thought vaping is less harmful than smoking (compared to those who did not) tended to vape more at home and in the car as might be expected given their perceptions of reduced risk, but reported vaping relatively less in smoke-free public places. The latter finding is hard to explain, perhaps those relatively few who have taken the trouble to obtain a realistic assessment of the risk, are also more sensitive to the concerns others might have about the impact of second-hand vapor. Enjoyment derived from vaping led to relatively more use in SF public places and also in private areas like homes and cars. The former suggests some vaping in public settings is to be able to use nicotine in places where smoking is not allowed.

Vapers who felt more comfortable around family vaped more in public places as well as at home. However, perceived social acceptability of vaping was not associated with

reported use in either private or public places, which is surprising. This may be related to the possibility that vapers only experience social disapproval when they vape in public, but may only do so when they think disapproval unlikely. It will be interesting to see if this lack of relationship persists if vaping becomes more common.

4.2. Policy Implications

The findings support the notion that regulation of PV use will affect both attitudes and vaping behavior, with less restrictive regulatory environment promoting more favourable attitudes towards PV use and greater occurrences of vaping in public and private settings. That said, we cannot rule out other reasons for the by-country effects. A careful consideration of what is an appropriate regulatory framework is needed to ensure that unnecessary barriers are not created for smokers wanting to switch to vaping. This would need to be balanced carefully by ongoing research to ensure that allowing vaping in SF public places does not lead to renormalization of smoking and that no health harm comes from exposure to second-hand vapor.

The findings also suggest that the regulatory environment for PV use may affect the extent of uncertainty and/or confusion around PV use. More Australian than UK respondents reported that they did not know how socially acceptable vaping was (36.7% vs. 10.5%) and how harmful they thought vaping was (36.2% vs. 17.3%), which may be due to the lower level of public engagement and less exposure to vaping (Yong et al., 2016) in the more restrictive regulatory environment in Australia. It suggests that differences in perceived harmfulness are not due to entrenched beliefs but lack of knowledge and experience. Some of the uncertainty in both countries is likely also to be a result of the ongoing public debate about the likely harms of PV use. Evidence-based public education is needed to address the misconceptions and uncertainty about PV use so that smokers, particularly those who are

unable and unwilling to quit and can benefit most from PV use, could make informed decisions about its use for harm reduction purposes (Brose et al., 2015; Yong et al., 2017).

4.3. Study Limitations

Our study has several other limitations. The data are cross-sectional, so that no causal attributions can be demonstrated. Secondly, the observed country differences may reflect some by-country differences in culture or sample characteristics other than the regulatory differences; however, we can think of no plausible candidate although we acknowledge that there could still be some unmeasured variables that have not been accounted for in our regression models. Thirdly, as our sample was limited to current and former smokers, our findings may not generalize to never smokers. Caution should also be used in generalizing these results to different regulatory regimes and quite different cultures. Fourthly, as noted earlier, the data on vaping in SF places do not distinguish between places where vaping might be allowed and where vaping is also prohibited. Fifthly, given the rapid changes over time in PV products, use and related policy, the findings based on 2014 survey data may no longer apply, so it will be interesting to follow-up to see how social acceptability changes. Finally, we observed some complex survey mode effects but can see no way they would change the above interpretations of the findings.

4.4. Conclusions

In conclusion, we have shown differences of attitudes toward vaping and vapers' use in both public and private places between the UK and Australia and think it most likely they are in large part due to the differences in the regulatory environments. The results are consistent with a model, but by no means prove, that regulation affects use which affects norms and social acceptance. Given increasing exposure to vaping, this would suggest we are likely to see further increases in PV use in the future to the extent that social normative

factors influence use. Considering the ongoing uncertainty and confusions about PV use, evidence-based public education is needed to reduce identified misconceptions.

Authors Disclosures

Role of Funding Source

The ITC Four-Country Survey is supported by multiple grants including R01 CA 100362 and P50 CA111236 (Roswell Park Transdisciplinary Tobacco Use Research Center) and also in part from grant P01 CA138389 and P01 CA200512 all funded by the National Cancer Institute of the United States, Robert Wood Johnson Foundation (045734), Canadian Institutes of Health Research (57897, 79551, 115016), National Health and Medical Research Council of Australia (265903, 450110, APP1005922), Cancer Research UK (C312/A3726), Canadian Tobacco Control Research Initiative (014578); SH and AM are members of the UK Centre for Tobacco & Alcohol Studies, a UK Clinical Research Collaboration Public Health Research: Centre of Excellence whose work is supported by funding from the Medical Research Council, British Heart Foundation, Cancer Research UK, Economic and Social Research Council, and the National Institute for Health Research under the auspices of the UK Clinical Research Collaboration (MR/K023195/1); AM and SH are also grateful for support from a Cancer Research secondary data analysis grant C25586/A19540.

Contributors

CL led the writing of the paper and conducted all the analyses; HHY and RB conceptualised the study design, guided statistical analysis, provided interpretation of the results, and contributed to drafting of the paper; AM and SCH helped with interpretations and drafting of the paper. All authors have approved the final manuscript.

Conflict of Interest

No conflict declared

Acknowledgements

We would like to thank the Data Management Core team based at the University of Waterloo, Canada for assisting with data preparation and cleaning.

References

ABS. (2015). National Health Survey: First Results, 2014-15 Retrieved 06 December 2017, from http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4364.0.55.001~2014-15~Main%20Features~Smoking~24

Action on Smoking and Health., 2016. Electronic cigarettes (also known as vapourisers) Retrieved Jan 08, 2016, from http://www.ash.org.uk/files/documents/ASH_715.pdf

Adkison, S.E., O'Connor, R.J., Bansal-Travers, M., Hyland, A., Borland, R., Yong, H.H., Cummings, K.M., McNeill, A., Thrasher, J.F., Hammond, D., Fong, G.T., 2013. Electronic nicotine delivery systems: International Tobacco Control Four-Country Survey. Am. J. Prev. Med. 44, 207-215. doi: 10.1016/j.amepre.2012.10.018

Ajzen, I., 2011. The theory of planned behaviour: Reactions and reflections. Psychol. Health, 26, 1113-1127. doi: 10.1080/08870446.2011.613995

Borland, R., 2014. Understanding hard to maintain behaviour change: A dual process approach. Melbourne: Wiley.

Borland, R., Yong, H.H., Cummings, K.M., Hyland, A., Anderson, S., Fong, G.T., 2006. Determinants and consequences of smoke-free homes: Findings from the International Tobacco Control (ITC) Four Country Survey. Tob. Control, 15 Suppl 3, iii42-50. doi: 10.1136/tc.2005.012492

Breland, A.B., Spindle, T., Weaver, M., Eissenberg, T.,2014. Science and electronic cigarettes: Current data, future needs. J. Addict. Med. 8, 223-233. doi: 10.1097/ADM.0000000000000049

Brose, L. S., Brown, J., Hitchman, S. C., & McNeill, A. (2015). Perceived relative harm of electronic cigarettes over time and impact on subsequent use. A survey with 1-year and 2-year follow-ups. [Research Support, Non-U.S. Gov't]. Drug Alcohol Depend. 157, 106-111. doi: 10.1016/j.drugalcdep.2015.10.014

Callinan, J. E., Clarke, A., Doherty, K., Kelleher, C., 2010. Legislative smoking bans for reducing secondhand smoke exposure, smoking prevalence and tobacco consumption. Cochrane Database Syst. Rev(4), CD005992. doi: 10.1002/14651858.CD005992.pub2

Chapman, S., 2013. Should electronic cigarettes be as freely available as tobacco cigarettes? No. B.MJ. 346. f3840. doi: 10.1136/bmj.f3840

Chapman, S. (2015). The future of electronic cigarette growth depends on youth uptake. Med. J. Aus., 202, 467-468.

Cooper, J., Borland, R., Yong, H.H., Hyland, A., 2010. Compliance and support for bans on smoking in licensed venues in Australia: Findings from the International Tobacco Control Four-Country Survey. Aust. N. Z. J. Public Health, 34, 379-385. doi: 10.1111/j.1753-6405.2010.00570.x

Eriksen, M., Mackay, J., Ross, H.,2015. The tobacco atlas (5th ed.). Atlanta, Georgia, USA: The American Cancer Society. Retrieved February 6, 2018. http://www.tobaccoatlas.org/

Etter, J.F., 2013. Should electronic cigarettes be as freely available as tobacco? Yes. B.M.J. 346, f3845. doi: 10.1136/bmj.f3845

Fairchild, A.L., Bayer, R., Colgrove, J., 2014. The renormalization of smoking? E-cigarettes and the tobacco "endgame". N. Engl. J. Med. 370, 293-295. doi: 10.1056/NEJMp1313940

Fong, G.T., Cummings, K.M., Borland, R., Hastings, G., Hyland, A., Giovino, G.A., Hammond, D., Thompson, M.E., 2006. The conceptual framework of the International Tobacco Control (ITC) Policy Evaluation Project. Tob. Control, 15 Suppl 3, iii3-11. doi: 10.1136/tc.2005.015438

Gravely, S., Fong, G.T., Cummings, K.M., Yan, M., Quah, A.C., Borland, R., Yong, H.H., Hitchman, S.C., McNeill, A., Hammond, D., Thrasher, J.F., Willemsen, M.C., Seo, H. G., Jiang, Y., Cavalcante, T., Perez, C., Omar, M., Hummel, K., 2014. Awareness, trial, and current use of electronic cigarettes in 10 countries: Findings from the ITC project. Int. J. Environ. Res.Public Health, 11, 11691-11704. doi: 10.3390/ijerph111111691

Hyland, A., Barnoya, J., & Corral, J. E. (2012). Smoke-free air policies: past, present and future. Tob Control, 21(2), 154-161. doi: 10.1136/tobaccocontrol-2011-050389

Hyland, A., Higbee, C., Borland, R., Travers, M., Hastings, G., Fong, G.T., Cummings, K. M., 2009. Attitudes and beliefs about secondhand smoke and smoke-free policies in four countries: Findings from the International Tobacco Control Four Country Survey. Nicotine Tob. Res. 11, 642-649. doi: 10.1093/ntr/ntp063

Institute for Global Tobacco Control., 2015. Country laws regulating e-cigarettes: A policy scan. Retrieved May 27, 2016, from http://globaltobaccocontrol.org/node/14052

King, B.A., Homa, D.M., Dube, S.R., Babb, S.D., 2014. Exposure to secondhand smoke and attitudes toward smoke-free workplaces among employed U.S. adults: Findings from

the National Adult Tobacco Survey. Nicotine Tob. Res. 16, 1307-1318. doi: 10.1093/ntr/ntu069

Lee, S., Grana, R.A., Glantz, S.A.,2014. Electronic cigarette use among Korean adolescents: Across-sectional study of market penetration, dual use, and relationship to quit attempts and former smoking. J. Adolesc. Health, 54, 684-690. doi: 10.1016/j.jadohealth.2013.11.003

Medicines and Healthcare Products Regulatory Agency., 2013. Licensing Procedure for Electronic Cigarettes and Other Nicotine Containing Products (NCPs) as Medicines Retrieved February 26, 2016, from http://www.mhra.gov.uk/home/groups/comms-ic/documents/websiteresources/con454361.pdf

Office for National Statistics., 2016. Adult smoking habits in Great Britain: 2014. Retrieved from https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/adultsmokinghabitsingreatbritain/2014

Qasim, H., Karim, Z.A., Rivera, J.O., Khasawneh, F.T., Alshbool, F.Z., 2017. Impact of electronic cigarettes on the cardiovascular system. [Review]. J. Am. Heart. Assoc. 6. doi: 10.1161/JAHA.117.006353

Sureda, X., Fernandez, E., Martinez-Sanchez, J.M., Fu, M., Lopez, M.J., Martinez, C., Salto, E., 2015. Secondhand smoke in outdoor settings: smokers' consumption, non-smokers' perceptions, and attitudes towards smoke-free legislation in Spain. B.M.J Open, 5. e007554. doi: 10.1136/bmjopen-2014-007554

Yong, H.H., Borland, R., Balmford, J., Hitchman, S.C., Cummings, K.M., Driezen, P., Thompson, M.E., 2016. Prevalence and correlates of the belief that electronic cigarettes are a lot less harmful than conventional cigarettes under the different

regulatory environments of Australia and the United Kingdom. Nicotine Tob. Res. 19, 258-263. doi: 10.1093/ntr/ntw137

Yong, H.H., Borland, R., Balmford, J., Hitchman, S.C., Cummings, K.M., Driezen, P., Thompson, M.E., 2017. Prevalence and correlates of the belief that electronic cigarettes are a lot less harmful than conventional cigarettes under the different regulatory environments of Australia and the United Kingdom. Nicotine Tob. Res. 19, 258-263. doi: 10.1093/ntr/ntw137

Yong, H.H., Borland, R., Balmford, J., McNeill, A., Hitchman, S., Driezen, P., Thompson, M.E., Fong, G.T., Cummings, K.M., 2015. Trends in e-cigarette awareness, trial, and use under the different regulatory environments of Australia and the United Kingdom. Nicotine Tob. Res. 17, 1203-1211. doi: 10.1093/ntr/ntu231

Figures and tables

Table 1. Sample characteristics

		Combined	UK	AU	UK vs AU comparison, p-value[a]
n		2849	1419	1430	
Age group (year, %)	18~39	32.8	35.2	30.4	0.012
	40~49	23.5	20.8	26.3	
	50~59	20.8	19.7	21.8	
	60+	22.9	24.3	21.5	
Gender (%)	Male	56.2	55.3	57.0	0.49
	Female	43.8	44.7	43.0	
Ethnicity (%)	White/English-speaking only	91.0	91.2	90.8	0.93
	Non-white/non-English-speaking	8.3	8.2	8.5	

Education level (%)	No information	0.7	0.6	0.8	0.072
	Low	43.5	44.2	42.8	
	Medium	32.2	29.6	34.8	
	High	23.6	25.4	21.8	
Household income (%)	No information	0.7	0.8	0.6	<0.001
	Low	24.6	27.8	21.5	
	Medium	26.8	29.6	24.0	
	High	40.2	35.0	45.4	
Wave of recruitment (%)	No information	8.3	7.7	9.0	0.028
	Wave 1~9	70.9	68.6	73.2	
	Wave 10	29.1	31.4	26.8	
Survey mode (%)	Telephone	28.2	32.3	24.0	<0.001
	Internet	71.8	67.7	76.0	
Smoking status (%)	Quitter	25.1	22.8	27.4	0.038
	Current smoker	74.9	77.2	72.6	
Vaping status (%)	Never	56.3	45.7	68.0	<0.001
	Past triers	23.7	26.1	21.3	
	Current <weekly use	10.1	12.0	8.2	
	Current <daily use	4.1	7.0	1.2	
	Current daily use	5.8	9.2	2.5	

Note: Percentages are based on weighted data.
[a] from chi-square test

Table 2. Attitudes towards PV use and use in private and public places

		Total (n=2849)		UK (n=1419)		AU (n=1430)		UK vs AU comparison, p-value[a]
		%	95% CI	%	95% CI	%	95% CI	
Among all respondents								
Social acceptability of vaping	Unacceptable	9.9	8.5-11.4	8.7	6.9-11.0	11.0	9.2-13.2	<0.001
	Neutral	24.3	22.3-26.5	24.3	21.5-27.4	24.4	21.5-27.5	
	Acceptable	42.1	39.7-44.5	56.4	53.0-59.8	27.9	24.8-31.2	
	Don't Know	23.7	21.7-25.8	10.5	8.5-12.9	36.7	33.5-40.0	
Harmfulness of vaping relative to regular cigarettes	More harmful	3.2	2.5-4.0	4.5	3.4-6.1	1.8	1.2-2.6	<0.001
	Equally harmful	13.8	12.2-15.5	14.3	12.0-16.8	13.3	11.3-15.7	
	Less harmful	56.3	53.8-58.7	63.9	60.5-67.2	48.7	45.2-52.2	
	Don't Know	26.8	24.7-29.0	17.3	14.7-20.1	36.2	33.0-39.5	
Among current vapers			n=570		n=404		n=166	
Comfortable using PVs in public		54.7	49.4-59.8	57.7	51.6-63.7	47.5	37.9-57.3	0.055
Comfortable using PVs around friends		70.1	65.2-74.7	70.7	64.7-76.1	68.8	59.7-76.7	0.832
Comfortable using PVs around family		62.8	57.6-67.7	64.4	58.4-70.0	58.9	48.9-68.2	0.399
Vaping in smoke-free public spaces		27.7	23.3-32.5	33.9	28.3-40.0	13.2	8.4-20.2	<0.001
Vaping at home		67.9	62.7-72.6	75.1	69.4-80.1	50.9	41.2-60.6	<0.001
Vaping in their car among those who had a car (n=507)		56.2	50.6-61.6	58.4	51.8-64.7	51.5	41.5-61.5	0.472

Note: Percentages are based on weighted data; [a] from chi-square test Table 3. Correlates of social acceptability of PV use by country

Table 3. Correlates of social acceptability of PV use by country

		UK (n=1419)		AU (n=1430)	
		aOR	95% CI	aOR	95% CI
Sociodemographic factors					
Age group[d] (in years)	60+	Ref		Ref	
	50~59	1.23	0.91-1.67	0.86	0.61-1.22
	40~49	1.01	0.72-1.40	1.17	0.81-1.69
	18~39	**1.71**[b]	1.20-2.44	0.95	0.63-1.43
Sex	Male vs female	0.97	0.77-1.21	1.13	0.87-1.45
Education	Low	Ref		Ref	
	Moderate	0.90	0.68-1.17	0.86	0.64-1.16
	High	0.95	0.71-1.29	0.98	0.69-1.38
Household income	Low	Ref		Ref	
	Moderate	0.93	0.69-1.24	0.90	0.63-1.28
	High	0.93	0.69-1.27	0.95	0.68-1.34
	No information	0.71	0.45-1.11	**0.50**[a]	0.29-0.88
Ethnicity	White/English-speaking	Ref		Ref	
	Non-white/Non-English speaking	0.86	0.55-1.36	1.38	0.87-2.20
	No information	1.45	0.33-6.31	0.67	0.08-5.62
Survey mode	Internet vs telephone	**0.61**[c]	0.47-0.79	**0.41**[c]	0.30-0.57
Wave of recruitment[d]	W10 vs W1~9	0.99	0.75-1.31	**1.59**[b]	1.11-2.26

Variables about smoking and vaping

Vaping status[d]	Never	Ref		Ref	
	Past triers	1.10	0.83-1.46	**1.98**[c]	1.45-2.71
	Current <weekly use	**2.17**[c]	1.49-3.17	**2.21**[c]	1.41-3.48
	Current <daily use	1.24	0.77-2.02	**3.48**[a]	1.37-8.86
	Current daily use	**1.67**[a]	1.09-2.56	1.80	0.83-3.90
Number of friends/family who vape regularly	0	Ref		Ref	
	1	1.05	0.78-1.40	**1.48**[a]	1.07-2.05
	2+	1.14	0.87-1.50	**1.53**[a]	1.02-2.28
Smoking status	Smoker vs quitters	**0.64**[b]	0.47-0.86	**0.71**[a]	0.51-0.99
Harmfulness of vaping relative to regular cigarettes	Less harmful vs others	**1.99**[c]	1.56-2.52	**2.19**[c]	1.68-2.85
Vaping seen in smoke-free public place[d]	No	Ref		Ref	
	Yes	**1.76**[c]	1.39-2.24	**1.83**[a]	1.10-3.04
	No information	1.33	0.78-2.28	**0.37**[b]	0.19-0.71

Note: Bolded estimates are significant at [a]p<0.05; [b]p<0.01; [c]p<0.001; aOR, odds ratios adjusted for variables in the table; CI, confidence intervals; Ref, reference category; [d]significant by-country interaction at p<0.05

Table 4. Correlates of PV use in private and public places among current vapers (n=570)

		In smoke-free public places		At home		In their car*	
		aOR	95% CI	aOR	95% CI	aOR	95% CI
Sociodemographic factors							
Country	UK vs AU	**2.66**[b]	1.50-4.70	**2.44**[c]	1.52-3.92	0.93	0.59-1.47
Age groups (in years)	60+	Ref		Ref		Ref	
	50-59	1.43	0.76-2.70	1.18	0.62-2.24	1.14	0.64-2.03
	40-49	1.17	0.59-2.30	0.90	0.48-1.69	1.28	0.70-2.33
	18-39	1.72	0.87-3.40	0.96	0.50-1.87	1.24	0.66-2.31
Sex	Male vs female	1.31	0.84-2.02	1.19	0.77-1.86	1.00	0.67-1.51
Education	Low	Ref		Ref		Ref	
	Moderate	1.11	0.66-1.87	0.87	0.52-1.45	1.15	0.70-1.87
	High	1.23	0.70-2.16	0.72	0.41-1.26	0.72	0.43-1.19
Income	Low	Ref		Ref		Ref	
	Moderate	0.77	0.42-1.39	0.87	0.48-1.60	1.25	0.71-2.19
	High	**0.54**[a]	0.30-0.96	**0.52**	0.29-0.92	1.30	0.76-2.23
	No information	**0.36**	0.14-0.95	0.65	0.25-1.65	**2.60**[a]	1.02-6.64
Ethnicity	White/English-speaking	Ref		Ref		Ref	
	Non-white/Non-English speaking	1.14	0.51-2.54	1.00	0.46-2.15	1.73	0.78-3.85
	No information	3.53	0.59-21.17	2.13	0.19-23.72	2.03	0.19-21.03
Survey mode	Internet vs telephone	1.38	0.82-2.34	1.35	0.82-2.22	**1.98**[b]	1.23-3.19
Wave of recruitment	W10 vs W1~9	0.89	0.53-1.49	0.77	0.48-1.25	0.94	0.59-1.49

History about smoking and vaping							
Smoking status	Smoker vs quitter	0.71	0.38-1.32	1.13	0.53-2.41	0.51	0.26-1.02
Vaping status	Current <weekly use	Ref		Ref		Ref	
	Current <daily use	1.70	0.95-3.04	1.31	0.74-2.33	1.21	0.70-2.07
	Current daily use	**1.94[a]**	1.11-3.40	**3.00[b]**	1.59-5.59	**2.23[b]**	1.31-3.79
Number of friends/family who vape regularly	None	Ref		Ref		Ref	
	1	1.49	0.79-2.78	0.85	0.48-1.51	0.95	0.55-1.66
	2+	1.40	0.83-2.34	1.23	0.74-2.04	1.36	0.85-2.18
Attitudes toward vaping							
Enjoy vaping	Disagreeing to agreeing	**1.53[b]**	1.16-2.01	**1.36[a]**	1.07-1.73	1.23	0.99-1.54
Social acceptability of PVs	Acceptable vs others	0.83	0.51-1.32	1.07	0.68-1.68	1.20	0.78-1.85
Comfortable vaping in public	Comfortable vs others	1.44	0.85-2.45	0.72	0.42-1.24	1.20	0.74-1.95
Comfortable vaping around friends	Comfortable vs others	0.65	0.31-1.35	1.13	0.59-2.16	1.84	0.98-3.46
Comfortable vaping around family	Comfortable vs others	**3.30[c]**	1.74-6.27	**2.67[b]**	1.51-4.72	0.79	0.45-1.39
Harmfulness of vaping relative to regular cigarettes	Less harmful vs others	**0.52[b]**	0.31-0.86	**2.03[b]**	1.27-3.24	1.56	0.98-2.48

Note: Bolded estimates are significant at [a]p<0.05; [b]p<0.01; [c]p<0.001; Ref, reference category;
*Data limited to those who reported owning a car (n=507)